WHAT IS CLAIMED IS:

1. A feedforward amplifier, comprising:

an input that accepts a radio frequency signal having multiple carriers;

a first control loop including a main amplifier block and a detector, wherein the first control loop generates a first carrier cancelled signal;

a second control loop including a pilot generator, I/Q demodulator, vector modulator and first error amplifier block, wherein the pilot generator, I/Q demodulator and first error amplifier block amplify the first carrier cancelled signal and generates a pilot signal;

a third control loop comprising a vector modulator and a second carrier cancellation detector; and

a fourth control loop comprising of vector modulator, a second error amplifier block, and a pilot signal receiver for receiving the pilot signal generated by the pilot generator in the second error amplifier block such that the pilot signal is reused by the fourth control loop to thereby further cancel intermodulation distortion in the output of the main amplifier block.

2. A feedforward amplifier according to claim 1, wherein main amplifier block generates an output spectrum comprising the multicarrier signal and intermodulation distortion signals.

3. A feedforward amplifier according to claim 1, wherein the main amplifier block comprises:

a predistortion network;

a first vector modulator controlled by independent I and Q control signals; and

a power amplifier,

wherein the I/Q modulator is adjusted to cancel the multicarrier signal in asymmetric carrier cancellation network such that an input to a pilot generator/error amplifier primarily comprises of intermodulation distortion signal of the main amplifier output and delayed input multicarrier signals.

4. A feedforward amplifier according to claim 3, wherein the first detector includes an asymmetric carrier cancellation network detector, and wherein the multicarrier signal is reinjected via the first control loop, and wherein the first control loop further comprises:

a first delay path having a first delayed output;

a first coupler disposed between the main amplifier block and the first delay path, wherein the coupler generates a coupled output

signal, wherein the through output is applied to a first delay path, and coupled output is applied to an input of the main amplifier block;

wherein a first delay path output is connected to the input of the first splitter;

wherein the first signal splitter is disposed between output of the first delay path and the first input of the asymmetric carrier cancellation network;

wherein a portion of the main amplifier spectrum is applied to the second input of the asymmetric carrier cancellation network; and

wherein the second signal splitter output is applied to the input of the third delay path.

5. A feedforward amplifier according to claim 4, further comprising:

a second coupler that extracts a portion of the main amplifier output spectrum;

a second delay path coupled to the output of the second coupler; and

a first injection coupler, wherein reinjection of the multicarrier error signal reduces output losses of the injection coupler.

6. A feedforward amplifier according to claim 1, wherein the second control loop further comprises:

a asymmetric carrier cancellation network that generates a first error output signal comprising primarily intermodulation distortion signals and input signal carriers;

wherein the pilot generator/error amplifier block is amplification means for the asymmetric carrier cancellation network output signal.

7. A feedforward amplifier according to claim 6, wherein the second control loop further comprises:

a second coupler;

a second delay path; and

an injection coupler, wherein reinjection of the error multicarrier signal reduces output losses of the injection coupler.

8. A feedforward amplifier according to claim 1, wherein the pilot generator/error amplifier block comprises:

a pilot signal injection coupler;

a I/Q pilot signal generator;

a second vector modulator;

an error amplifier;

an output coupler;

a plurality of analog integrators; and

an in-phase/quadrature (IQ) demodulator that compares the I and Q of the pilot signal(s) sampled at input to the pilot signal injection coupler and output coupler to generate I and Q error control signals that are input to first and second analog integrators, respectively.

9. A feedforward amplifier according to claim 8, wherein the output of each integrator is the bias to the respective control inputs of the second vector modulator.

10. A feedforward amplifier according to claim 1, wherein the portion of output main amplifier spectrum is coupled through the third vector modulator, further comprising:

a carrier cancellation coupler, wherein the portion of output spectrum is applied to an input of the carrier cancellation coupler, and wherein the third vector modulator is controlled by adjustable I and Q controls.

11. A feedforward amplifier according to claim 10,

wherein the carrier cancellation coupler has a first input and a second input, wherein the second input is the output of the third delay path that comprises only the delayed input multicarrier signals;

wherein the third vector modulator is adjustable to cancel the input multicarrier signal present in carrier cancellation coupler output port such that input to the second error amplifier block primarily comprises intermodulation distortion signals from an output of the second loop.

12. A feedforward amplifier according to claim 11, wherein the second carrier cancellation detector determines a signal voltage level of an envelope of the multicarrier signal that is utilized to adjust I and Q controls of the third vector modulator.

13. A feedforward amplifier according to claim 12, wherein the third control loop further comprises:

a carrier cancellation coupler; and

a third coupler that extracts a portion of output spectrum from the output of the second control loop comprising both amplified multicarrier input signal, residual intermodulation distortion signals and pilot signal.

14. A feedforward amplifier according to claim 1, wherein the fourth control loop further comprises:

a carrier cancellation coupler that generates an output comprising primarily intermodulation distortion signals and a pilot

signal, wherein the second error amplifier block is amplification means to the output of the carrier cancellation coupler.

15. A feedforward amplifier according to claim 14, wherein the fourth control loop further comprises:

a third coupler;

a fourth delay path;

a second injection coupler; and

a receiver output coupler.

16. A feedforward amplifier according to claim 15, wherein the second error amplifier block comprises:

a fourth vector modulator that is adjusted so as to minimize the amplitude of the pilot signal at the receiver output coupler; and

a second error amplifier.

17. A feedforward amplifier according to claim 1, wherein the first carrier cancellation detector comprises an asymmetric carrier cancellation network detector, and wherein the first control loop comprises:

a first carrier cancellation junction having output port connected to a first carrier cancellation detector, wherein a portion of the forward power delivered from main amplifier block

output is coupled to the first input port and coupled portion of input multi carrier signals are coupled to the second port of said signal cancellation junction;

a second carrier cancellation junction having output port connected to input port of the first error amplifier block, wherein a portion of the forward power delivered from main amplifier block is coupled to the first input port and portion of input multi carrier signals are coupled to the second port of said summing junction; and

asymmetric carrier cancellation detector which allows for first injection coupler load power minimization via the asymmetric carrier cancellation detector.

18. A feedforward amplifier according to claim 17, wherein the asymmetric carrier cancellation detector network, comprises:

a first divider network that receives delayed input carrier signals from first splitter output port, and generates a first output signal to second input port of the first carrier cancellation junction and a second output signal that is input into second input port of the second carrier cancellation junction;

a carrier cancellation detector that receives signal from the output port of the first carrier cancellation junction;

a second carrier cancellation junction substantially matched to first carrier cancellation junction, wherein the first input port is coupled to attenuator network;

a second divider network substantially matched to the first divider network, responsive to an output from the main amplifier, that generates a first divider output signal coupled to the first input port of the first carrier cancellation junction and a second divider output signal coupled to attenuator network;

an attenuator network coupled between first input port of the second carrier cancellation junction and, wherein the level of extra delayed input carrier power is determined by the value of the attenuator network, second output port of a second divider network output; and

a directional coupler that is used to monitor the input to the error amplifier,

wherein the carrier cancelled signal is only used in conjunction with a controller such that a minimum power is provided at the carrier cancellation detector.

19. A feedforward amplifier according to claim 18, further comprising:

a second carrier cancellation junction,

wherein a second carrier cancellation junction, is formed when the second portion of input carrier signals are delivered from first divider network and combined with the balance of attenuated signals from the main amplifier output delivered from the second divider network through attenuator network to second signal cancellation junction.

20. A feedforward amplifier according to claim 17, wherein the multicarrier signal is reinjected via the first control loop, and wherein the first control loop further comprises:

a first delay path having a first delayed output;

a splitter disposed between the asymmetric carrier cancellation network and the first delay path, wherein the splitter generates a divided output by dividing the delayed output, wherein the divided output is applied to a third delay path, and

wherein the asymmetric carrier cancellation network detector has a first input and a second input,

wherein a portion of the main amplifier output spectrum is applied to the first input,

wherein the divided output is applied to the second input.

21. A feedforward amplifier according to claim 20, further comprising:

a second coupler that extracts a portion of the main amplifier output spectrum; and

an injection coupler, wherein reinjection of the multicarrier signal reduces output losses of the injection coupler.

22. A feedforward amplifier according to claim 21, wherein the asymmetric carrier cancellation network generates a first output signal comprising primarily intermodulation distortion signals and input signal carriers, wherein the pilot generator/error amplifier block is amplification means to the first output signal.

23. A feedforward amplifier according to claim 17, wherein the second control loop further comprises:

a second coupler; and

an injection coupler, wherein reinjection of the multicarrier signal reduces output losses of the injection coupler.

24. A feed forward amplifier comprising:

a first coupler;

a first delay path coupled to the output of the first coupler;

a first signal splitter, wherein input is coupled to the output of the first delay path;

a third delay path coupled to the first output of the first

delay splitter;

a asymmetric carrier cancellation network, wherein asymmetric carrier cancellation network second input is coupled to the first output of the first splitter, wherein output is coupled to the input of the pilot injection coupler;

a first vector modulator adjusting circuit having an input coupled to an output of the input coupler;

a predistortion network having its input coupled to output of the first vector modulator adjusting circuit;

a main amplifier having an input coupled to the output of the predistortion network;

a second coupler having an input coupled to an output of the main amplifier;

a second delay path having an input coupled to an output of the second coupler;

a first injection coupler having an input coupled to an output of the second delay path;

a sampling coupler having an output coupled to a injection port of the injection coupler;

a first error amplifier having an output coupled to an input of the sampling coupler;

a second vector modulator adjusting circuit having an output coupled to an input of the first error amplifier;

an pilot injection coupler having an output coupled to an input of the second vector modulator adjusting circuit;

a pilot generator having an output coupled to the injection port of the pilot injection coupler; and

an I/Q demodulator having a first input port coupled to a pilot generator output, and a second input port coupled to a coupled port of the sampling coupler.

25. A feed forward amplifier of claim 24, further comprising:

I/Q demodulator receives reference signal(s) from pilot generator;

a pilot signal generator that generates I/Q modulated pilot signal;

a pilot injection coupler having an injection port coupled to the output of the pilot generator;

a constant gain and phase loop that utilizes the pilot signal difference detected by I/Q demodulator, wherein the loop comprises a first error amplifier block that amplifies the error multicarrier signal, wherein the first error amplifier block includes an adjustable vector modulator; and

a feedback path between the output of the first error amplifier output and second vector modulator in the first error amplifier

that allows the first error amplifier loop to use pilot signal to maintain constant phase and amplitude of the first error amplifier.

26. A feedforward amplifier according to claim 25, wherein the feedback path comprises:

a I/Q demodulator that detects I/Q modulated pilot signal at sampling coupler; and

an injection coupler, wherein a controlled level of the input multicarrier signal is reinjected through the first error amplifier to reduce the magnitude of the multicarrier signal at a coupler termination and thereby cancel intermodulation distortion in an output signal of the main amplifier.

27. A feedforward amplifier according to claim 26, wherein the first detector output is coupled to the main amplifier block.

28. A feedforward amplifier according to claim 26, further comprising:

means for adjusting I and Q controls based on the control signal generated by the first detector.

29. A feedforward amplifier according to claim 28, wherein the first detector generates the I and Q control signals which are used to adjust first vector modulator to maintain gain and phase of the output of main amplifier block at set value.

30. A feedforward amplifier having an input that accepts radio frequency signals, a feedforward path, a first error amplifier, a second error amplifier, and an output, comprising:

first means for reducing intermodulation distortion produced by the feedforward amplifier by reinjecting the input multicarrier and error signals into the feedforward path;

means for stabilizing insertion phase and gain of the first error amplifier and generating a pilot signal;

means for canceling the multicarrier signal at an input of the second error amplifier; and

second means for reducing intermodulation distortion at an output of the feedforward amplifier that provides the pilot signal to an input of the second error amplifier block such that the pilot signal is reused by the second means for reducing intermodulation distortion to thereby further cancel intermodulation distortion.

31. A feedforward amplifier according to claim 30, wherein the first means for reducing comprises:

a first control loop comprising means for amplifying and a first means for detecting, wherein the multicarrier signal is reinjected via the second control loop, wherein the first control loop generates a error and multicarrier signals.

32. A feedforward amplifier according to claim 30, wherein the means for stabilizing comprises:

a second control loop comprising means for generating a pilot and means for error amplifying and the first means for I/Q pilot detecting, wherein the means for error amplifying is responsive to the carrier cancelled signal.

33. A feedforward amplifier according to claim 30, wherein the means for canceling comprises:

a third control loop comprising means for I and Q adjusting and a second means for detecting.

34. A feedforward amplifier according to claim 30, wherein the second means for reducing comprises:

a fourth control loop comprising the means for I and Q adjusting, a second means for error amplifying, and means for receiving a pilot signal.

35. A feedforward amplifier according to claim 31, wherein means for amplifying generates an output spectrum comprising the multicarrier signal and residual intermodulation distortion signals.

36. A feedforward amplifier according to claim 31, wherein the means for amplifying comprises:

a predistortion network;

means for gain and phase adjusting controlled by independent I and Q controls; and

a power amplifier,

wherein the means for I and Q adjusting is adjusted to cancel the multicarrier signal in a first means for carrier cancellation such that an input to means for generating a pilot/error amplifier primarily comprises the intermodulation distortion signal of the main amplifier output and multicarrier signals.

37. A feedforward amplifier according to claim 36, wherein the first control loop further comprises:

a first means for coupling having a first input and a second output and coupled output,

a first means for delaying having a first delayed output;

a splitter disposed between the first means for coupling and the first means for delaying, wherein the splitter generates a divided output by dividing the delayed output,

wherein a first divided output is applied to second input of asymmetric carrier cancellation network, and

wherein second divided output is applied to a third means for delaying,

a second means for coupling having an input and output and coupled output,

wherein main amplifier output is coupled to the second means of coupling input,

wherein a portion of the main amplifier output spectrum is coupled by the second coupling means,

wherein the main amplifier output coupled spectrum is applied to the first input of asymmetric carrier cancellation network.

38. A feedforward amplifier according to claim 37, further comprising:

a second means for coupling that extracts a portion of the main amplifier output spectrum; and

a first means for injection coupling, wherein reinjecting amplified multicarrier signal into the feedforward path to reduce output losses of the first means for injection coupling.

39. A feedforward amplifier according to claim 32, wherein the second control loop further comprises:

a second means for coupling; and

a third means for injection coupling, wherein reinjecting the multicarrier signal into the feedforward path reduces output losses of the first means for injection coupling.

40. A feedforward amplifier according to claim 32, wherein the means for generating a pilot for error amplifying comprises:

a pilot signal injection means for coupling;

a quadrature modulated signal generator;

a second means for gain and phase adjusting;

a first error amplifier;

an output means for coupling;

first and second analog integrators; and

an I/Q demodulator that compares the gain and phase of the pilot signal sampled at pilot signal injection means for coupling and output means for coupling to generate I and Q error control signals that are input to the first and second analog integrators, respectively.

41. A feedforward amplifier according to claim 40, wherein the output of each integrator is the bias to the respective control inputs of the second means for I and Q adjusting.

42. A feedforward amplifier according to claim 33, wherein the portion of output spectrum is coupled through the means for gain and phase adjusting, further comprising:

a third means for coupling, wherein the portion of second loop output spectrum is applied to an input of the third means for coupling, and

wherein the means for I and Q adjusting is controlled by adjustable I and Q controls, respectively.

43. A feedforward amplifier according to claim 42,

wherein the third means for coupling has an input, output and coupled port, wherein the output is the input of the third means for delaying that comprises the output of the second loop;

wherein the third means for coupling coupled port is an input to third vector modulator

wherein the third vector modulator is adjustable to cancel the multicarrier signal present in second means for carrier cancellation such that input to second means for error amplifying primarily comprises intermodulation distortion signals from an output of the second loop.

44. A feedforward amplifier according to claim 52, wherein the first means for detecting determines a signal voltage level of an envelope of the error signal, wherein the envelope of the signal voltage level of the error signal is utilized to adjust adjustable third I and Q controls.

45. A feedforward amplifier according to claim 44, wherein the third control loop further comprises:

a third means for coupling;

a fourth means for delaying; and

a second means for injecting error signal to further cancel intermodulation signals.

46. A feedforward amplifier according to claim 30, wherein the fourth control loop further comprises:

a second means for carrier cancellation that generates an output comprising primarily intermodulation distortion signals, wherein the second means for error amplifying is responsive to the output of second means for carrier cancellation.

47. A feedforward amplifier according to claim 46, wherein the fourth control loop further comprises:

a third means for coupling;

a second means injecting error signal; and

a final output means for coupling.

48. A feedforward amplifier according to claim 47, wherein the second means for error amplifying comprises:

a fourth vector modulator

wherein I and Q adjusting that is adjusted so as to minimize the amplitude of the pilot signal at the final output means for coupling; and

an error amplifier.